Comments on to P. Anderson's Review of The Dappled World

Nancy Cartwright[1]

This review of *The Dappled World* is grossly inaccurate. It claims that the book "seems to quote with approval from some of the deconstructionist literature". I have nothing against deconstructionist literature but the book is a work of analytic philosophy, start to finish; no deconstructionist literature is cited. The review also offers a very different account: "On crucial matters [the book's author] is a social constructionist." Again, the book is a work of analytic philosophy; it is no more social constructionist than it is deconstructionist.

The review does not describe the theses of the book carefully, or correctly. Nor does it present the arguments for the theses. At various places it misacribes. For example, the quotation cited to confirm the book's social constructionist stance is instead a description provided of the social constructionist position. It is followed by the opposing view of the exasperated realist scientist, with the clear implication that there is good reason for the scientist to be exasperated. The book is alleged to advocate funds for child care and preventative medicine, which, though indeed "worthy causes", are not mentioned in its pages. By his own account the reviewer did not read the whole book but "by-pass[ed] the extensive discussion" of the last chapter, which is one of the two chapters specifically about physics.

The Dappled World defends scientific realism: well-supported claims of science have as good a claim to truth as any: and, contrary to what the review reports, it maintains that there *are* "general laws of physics with which all must be compatible." The chapter "Where do laws of

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nature come from?" describes the kinds of situations in which 'lawlike' (i.e., regular) behaviour occurs. The review tells you the discussion is about how scientists *discover* laws.

The Dappled World argues that we have more evidence for a "patchwork" of law than for the universal rule of order. My worry is that many scientific proposals gain unwarranted credibility because they come from our best candidates for a theory of everything: strings, genes, game theory or evolutionary psychology. One possible example is non-gene-based breast-cancer research that had difficulty getting funded but is now acknowledged as a good bet.

One of my central arguments for a patchwork is the interconnectedness of science that Anderson maintains I ignore. How do our best sciences work when they have their greatest empirical successes? Here we always find different branches of science acting as a "confederacy"[2] with no one theory providing all the necessary tools. I illustrate with examples of co-operation between quantum and classical theories. The reviewer objects that I omit decoherence, a currently fashionable way to treat quantum reduction. I study far more varied relations between quantum and classical quantities: local identifications, causal interactions, joint action and piecemeal correction. These are what we see when we look at how physics produces the spectacular successes that make it credible.

As with God's goodness and the problem of evil, there are well-known ways, which Anderson recites, to reconcile how successful science is practised with the metaphysics of the single unifying theory. The one-great-theory theory is not incompatible with the evidence; it's just badly supported by it.

[2] See Hoddeson, the work praised by the reviewer, p. viii, on solid-state physics.

I do claim that there are articulable domains within which a theory can be relied on to make precise predictions. Central mathematical expressions in physics apply to the world via specific concrete descriptions (called "interpretative models"); eg, the Bloch Hamiltonian is appropriate when a material can be modelled as a Bravais lattice. To apply quantum mechanics, we must fit quantum models to all the relevant factors operating; others must be eliminated or calculated away ('shielded against'). Far from endangering the growth of physics, as Anderson says, the fact that there are systematic rules for how to use physics' expressions is part of what makes physics powerful.

Nor does that mean we never learn anything new. As Anderson says, "BCS taught us a new way in which quantum fields could act". But not by ad hoc manoeuvre, as my case study of BCS and all its contemporary alternatives illustrates: superconductivity was brought under quantum theory by discovering how to fit to it the interpretative models quantum mechanics provides. Anderson cares about the seven years after BCS. My claims hold even more strongly there.

We cannot have it both ways. We believe in physics' theories because their predictions are reliable. But the theories *as used for these predictions* apply exactly where their interpretative models fit.

Anderson thinks renormalizability helps. I don't. The significance of renormalizability is just not clear enough. But assume his view of its significance is right. Then we could unify "upwards" across the theories we have. But the extension of these theories is fixed by the range of its interpretative models. This does not yield 'boundless' physics.

And outside the bounds? Anderson uses the loose language of the economist: physics gives us ‘understanding’ even where it does not give precise prediction. How? I work hard in the book to produce an account that makes sense, based on earlier work on capacities and probabilistic causality.

Anderson urges Baysian epistemology, which requires hypotheses and evidence to be prearticulated. It is a poor choice for physics, which regularly introduces new concepts and new kinds of experiment. I don’t presuppose any specific epistemology—except for insisting that evidence is what matters. Hypotheses must gain credibility only from the empirical evidence, not because they serve some favoured metaphysical or political scheme.

We know that scholars have failed to obtain positions and promotions because they have been charged with the labels employed in this review. I think we must then call for a higher standard of precision to keep our scholarly journals fixed on the intellectual issues.